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CURRICULUM GUIDE

Vocational Series

AGRICULTURAL MECHANICS 22 - 32

(Interim Edition, September, 1966)

Province of Alberta

Department of Education

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FOREWARD

In the beginning, all crops necessary to feed mankind were produced and prepared by human muscle power. In 1854 farm tools were so crude that one farm worker could only produce sufficient food for himself and four or five others. By 1963, it was estimated that one farm worker could produce sufficient to support himself and about thirty others. In fact each farm worker today supplies twice as many people as in 1950. This is the resulf of a technological revolution in agriculture. There has been rapid progress in farm mechanization and greatly increased yields of crops and livestock because of widespread adoption of improved farm practices.

The continually increasing rate of development in modern farming imposes greater demands on the knowledge and abilities of those who will be working in the industry in the future. It is no longer sufficient for a young man entering farming as a career, to acquire the skill and knowledge in a vicarious manner; he must understand the principles which underlie them in order to adapt and acquire for himself the new techniques and skills as they develop. In no facet of farming is this more true than in the operation, servicing and maintenance of the complex, expensive equipment that has in large part been responsible for the increased productivity. The selection of the content of this curriculum is based on the knowledge of the needs of young men entering this industry and also what their employers might reasonably expect from them.

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GENERAL OBJECTIVES

The purpose of this program is:

(1) To enable the student to develop skill in the correct use and care of hand and machine tools required for the servicing and maintenance of farm machinery and equipment.

(2) To develop an understanding of the design and operating principles of farm machinery in order that the student may repair and service the equipment intelligently.

(3) To develop habits which will result in good use of time and materials, good working relationships and safe practices.

GENERAL INFORMATION

(1) Course Credit Values:

Agricultural Mechanics 22 - 20 credits

Agricultural Mechanics 32 - 15 or 20 credits

(2) Safety Program:

Every shop must have an effective safety program. In the agricultural mechanics shop particular attention must be given to the safety measures required in the industry: adequate guards; cleanliness of shop and personnel maintained at a high standard; students properly clothed for their work; etc. The shop organization must be such as to ensure stressing this very important phase of the shop program.

A good safety program features the following devices: regular, consistent and thorough instruction; constant vigilance and checking by the instructor; safety posters; student safety committee; adequate first aid equipment; instructor trained and up-to-date in first aid methods; dynamic color painting of machines and equipment; adequate working space about machines; safety lines on floor around machines; routine report on accidents however minor; machines and tools in approved working condition; a safety-conscious group of students and instructor.

(3) Instructors' Records:

The instructor should keep accurate records of:

a. student enrolment and attendance
b. student accounts
c. student work activity
d. theory covered
e. tests given
f. student achievement
g. up-to-date inventory of all equipment

(4) Students' Records:

Instructors should ensure that students develop and maintain a neat and accurate record of:

a. theory that is given
b. daily shop activities (time cards)

(5) Guidance and Vocational Information:

Instructors must assume responsibility in their own trade area to ensure that students and school guidance officials are aware of the local situation. It is essential that instructors be active, interested and informed regarding the opportunities in their field.

AGRICULTURAL MECHANICS 22

This course consists of four major divisions each of which will require approximately 5 credits of time. The divisions are:

I - Welding - 5 credits

II - Farm Shop - 5 credits

III - Farm Power Units and Power Transmission - 5 credits

IV - Farm Machinery - 5 credits

TEXTS

"Shopwork on the Farm", Mack M. Jones, 2nd edition, Webster-McGraw-Hill Book Co.

"Farm Machinery and Equipment", H. P. Smith, 5th edition, McGraw-Hill Book Co.

WELDING

(5 credits)

The welding taught to agricultural students should provide sufficient skill and knowledge so that intelligent solutions and satisfactory welds can readily be made to most farm welding operations.

Theory that is common to welding and farm shop (grinding, filing, drilling, etc.) should be taught in Farm Shop and that welding theory only be taught in the welding course as follows:

Oxy-Acetylene Welding

Using and Storing Equipment

Operations	Basic Information	References
1. Discussion	a. History of oxy-acetylene	
2. Safe handling and storing oxygen cylinders.	b. Capacity in cubic feet of cylinders	
	c. Pressure	
	d. Sizes and weights of cylinders	
	e. Importance of proper storing, handling and occupational hazards	
	f. Advantages of manifold system	
	g. Construction and operation of valve	
	h. Shop pipeline distribution	
3. Handling and storing acetylene cylinders	a. Cylinder filling	
	b. Purpose of acetone	
	c. Safety plugs	

Operations	Basic Information	References
	d. Construction and operation of valves	
	e. Capacity in cubic feet	
	f. Different sizes and weights of cylinders	
	g. Advantages of manifold system - precaution in use	
	h. Cylinder pressure	
	i. Importance of proper storing and handling	
4. Handling and storing cylinders of other gases	a. Types and precautions	
	b. Storage of calcium	
	c. Economics of gas production	
	d. Safe practices	
	e. Ice Formation	
	f. Traps	
	g. Advantages and disadvantages; disposal of spent carbide	
5. Setting up equipment	a. Reasons for securing	
a. Positioning and securing cylinders	b. Reasons for 'cracking' valves	

Operations	Basic Information	References
b. 'Cracking' cylinder valves	c. Construction and operation of regulators	
c. Attaching regulators	d. Pre-set, single stage and two-stage regulators	
d. Connecting hoses to regulators	e. Function of adjusting screw	
e. Connecting torch handle to hoses	f. Identifying acetylene equipment	
f. Attaching welding tip to handle	g. Hose sizes	
g. Opening cylinder valves	h. Blowing out hoses	
h. Adjusting working pressure	i. Features and functions of torch handles - H.P.: L.P.: M.P.: or E.P.	
i. Balancing equal pressure torches	j. Types of welding tips and met ods of attaching	
j. Testing for leaks.	k. Opening cylinder valves	
	l. Adjusting for working pressure	
	m. Testing for leaks	
	n. Opening acetylene cylinder valve	
	o. Danger of using oil with oxygen	
6. Metallurgy	a. Chemistry of flame C_2H_2 O_2 2CO H_2	
	2CO O_2 $2CO_2$	
	$2H_2$ O_2 $2H_2O$	
	b. Effect of three types of flame on mild steel	

Operations	Basic Information	References
	c. Melting points	
	d. Effects of heat on metals	
	e. Effects of quenching welds	
7. Using oxy-acetylene equipment	a. Gas pressure in relation to tip size	
a. Lighting the torch	b. Purpose of three kinds of flame	
b. Adjusting to correct flame	c. Temperatures of flames	
	d. Cleaning tips	
	e. Shapes of cones	
	f. Terms used in connection with welding	
	g. Reconditioning a damaged tip	
	h. Flashbacks and backfires	
	i. Care, maintenance and use of goggles, protective equipment and personal clothing	
	j. Repairing hoses	
8. Disassembling and storing oxy-acetylene equipment	a. Importance of sequence in turning off torch valves	
a. Turning off torch	b. Method of closing cylinder valves	

Operations	Basic Information	References
b. Closing cylinder valves	c. Sequence for releasing line pressure - danger of releasing free acetylene	
c. Releasing pressure in lines	d. Disconnecting tips, handle hose	
d. Disconnecting tip and handle	e. Taking down regulators	
e, Disconnecting hoses	f. Reasins for safety caps	
f. Taking down regulators	g. Handling cylinders	
g. Securing safety caps	h. Storing	
h. Storing in dry clean place	i. Coiling hoses	
i. Simple reconditioning of gauges	j. Relieving spring pressure regulator valve seats	
	k. Pipeline regulators, line valves, check valves bursting discs	

WELDING FERROUS METALS

Operations	Knowledge
1. Preparing job and equipment	a. Dressing in preparation for welding; gloves, goggles, other clothes.
	b. Identification of metals.
	c. Necessity of cleaning metals.
	d. Necessity of clamping work.
	e. Joint preparation - bevelling, etc.

Operations	Knowledge
2. Running a bead	a. Size of tip
a. Without filler rod on 14 ga M/S	b. Type of filler rod
b. With filler rod on 14 ga M/S	c. Size of filler rod
	d. Need for preparation
	e. Movement of torch
	f. Distance of central cone of flame from work
	g. Speed of travel
	h. Puddle formation
	i. Angle and inclination of tip with work
	j. Size of bead
	k. Need for welding in different positions
	l. Forehand technique
	m. Effect of different flame settings of metal
3. Welding sheet metal	a. Spacing of tack weld in relation to metal thickness.
a. Butt weld 16 ga M/S with filler rod (flat) and 45°	b. Appearance of finished weld
	c. Importance of forehand technique only
	d. Method of obtaining penetration and correct reinforcement
	e. Effect of heat on metals; expansion and contraction
	f. Backstep method

Operations	Knowledge
4. Welding mild steel plates	
a. Butt weld 16 ga M/S (Flat and 45°)	
b. Butt weld 1/8 ga M/S (Flat and 45°)	
c. Butt weld 3/16 ga M/S (Flat and 45°)	
d. Open corner weld 16 ga M/S (Flat and 45°)	
e. Open corner weld 1/8 M/S (Flat and 45°)	
f. Open corner weld 3/16 ga M/S (Flat and 45°)	

BRAZEWELDING AND BRAZING

Contents

1. Brazewelding mild steel (5 hours)

Operations	Knowledge
1. Brazewelding mild steel (flat)	a. Definition of brazewelding
	b. Characteristics and properties of filler metal
	c. Preparation of base metal
	d. Flux
	e. Recommended flame setting

Operations	Knowledge
	f. Tinning
	g. Advantages and limitations of this process
	h. Recommended sequence
	i. Ventilation

CUTTING

Operations	Basic Information	References
1. Cutting mild steel and low alloy steel-	a. Cutability of metals	
a. Adjusting oxygen and acetylene pressures	b. Types of torches and tips	
b. Lighting and adjusting flame	c. Sizes of cutting tips	
	d. Gas pressures	
c. Preheating the metal	e. Angle and distance of flame from work	
d. Starting the cut	f. Starting a cut and speed of travel	
e. Restarting a lost cut	g. Chemistry of cutting	
f. Cleaning tips	h. Cutting faults and causes	
g. Cutting round	i. Cutting guides	
h. Cutting heavy plate	j. Rivet cutting nozzles	
i. Cutting rivets	k. Tip cleaning and reconditioning	
j. Piercing a hole in plate	l. Starting cut in middle	
	m. Removing slag	
	n. Nozzles for gases other than acetylene	

Operations	Basic Information	References
2. Cutting with gases other than acetylene - natural gas propane (optional)	a. Controlling distortion in long cuts	
3. Cutting mild steel pipe	a. Hand cutting to a line	
	b. Square and bevel cut	
	c. Radial cut	
	d. Starting cut on a pipe	
3. Bevel cutting - Freehand	a. Procedure for freehand cutting	
	b. Angle of bevel	
	c. Tip size	
	d. Gas pressure	
	e. Position of preheat orifice	
4. Cutting cast iron	Methods	
ELECTRIC ARC WELDING		
INSTALLING AND USING WELDERS		
1. Discussion	a. History of electric arc welding	
2. Using D. C. welder (motor driven)	b. Identification of make and capacity	
	c. Characteristics of available power	
	d. Principles of direct current	
	e. Advantages and disadvantages of D.C. welders	
	f. Capacity and use of cables and electrode holders	

Operations	Basic Information	References
3. Using A. C. transformer welder	a. Identification of make and capacity.	
	b. Principles of alternating current.	
	c. Advantages and disadvantages of A. C. transformer welders.	
	d. Capacity and use of cables and electrode holders.	
	e. Switches and controls.	
4. Using D. C. rectifier welder	a. Identification of make and capacity.	
	b. Elementary electricity.	
	c. Switches and controls.	
	d. Advantages of selenium and other rectifiers.	
	e. Capacity and use of cables electrode holders.	
	f. Advantages and disadvantages of D. C. rectifier welders.	
WELDING FERROUS METALS		
1. Preparing job and equipment	a. Dressing in preparation for welding; face and eye protection, gloves, other clothes.	
	b. Necessity of cleaning metal.	
	c. Necessity of clamping work.	
	d. Grounding work.	
	e. Effect of thickness on edge preparation.	

Operations	Basic Information	References
	d. Grounding work	
	e. Effect of thickness on edge preparation	
	f. Techniques which minimize buckling	
	g. Importance of identifying metal	
2. Running a bead	a. Selection of the correct type of electrode	
a. Padding $\frac{1}{4}$ x 4 x 4 coupon using E6010, E6011, E6012, E6013, E6014, electrodes on DC and AC machines.	b. Heat control - voltage and amperage	
	c. Method of striking an arc	
	d. Distance of electrode from plate	
	e. Starting a bead	
	f. Speed of forward movement	
	g. Stopping and restarting a bead	
	h. Core wire composition	
	i. Flux or coating composition and use	
	j. Importance of cleaning weld	
	k. Chipping hammer - importance of correct type	
	l. Safety - arc flash, clothing, eye protection, electric shock	
3. Welding mild steel plate	a. Importance of material classification	
a. $\frac{1}{4}$" butt weld (flat)	b. Classification and sizes of electrodes	

Operations	Basic Information	References
b. 3/16" butt weld (flat) c. 1/8" butt weld (flat)	c. Difference between A.C. and D.C. Straight and reverse polarity welding d. Machine setting e. Acceptable size and shape of bead f. Single and multi-pass welds	

THE FARM SHOP

(5 credits)

SPECIFIC OBJECTIVES

The objectives of this program are to enable the student:

1. To develop correct use and care of common hand and machine tools used on the modern farm.

2. To know and understand the metals he is using and their characteristics which will enable him to apply this knowledge in the field of general repair work.

3. To develop an attitude of safety consciousness regarding all phases of farm work.

INTRODUCTION

Operations	Basic Information	References
1. Discussion	a. Metals, properties and uses	
2. Films	a. Production of iron ore	
	b. Blast furnace	
	c. Refining	
	d. Properties of iron	
	e. Tensile strength	
	f. Non-ferous metals	
	g. Alloys	
	h. The many forms of each available	
	i. Identification of metals	

Operations	Basic Information	References
3. Making a working drawing	a. Design of project	
	b. Reading working drawings & blueprints	
4. Measuring, cutting stock & application of plan	a. Coloring of metal surface for layout. Measuring tools such as: steel rule, scribers, squares, prick punch, dividers, calipers, micrometers, gauges of wire and sheet metal.	

As the files, hack saws, hammers, chisels and punches will be the most used hand tools for "on the job repair", heavy emphases will be given to these. It would seem that the making of tools will lend themselves best. Consequently bench metal will be the core and from this branch to machine metal, hot metal and some sheet metal.

BENCH METAL

Operations	Basic Information	References
1. Machinist vise	a. Kinds	
	b. Sizes	
	c. Jaws	
	d. Positioning of work	
	e. Protection of working surfaces	
2. Hammering	a. Types, features and applications of hammers, e.g. machinists, riveting, soft, mallets.	

Operations	Basic Information	References
3. Chiselling	a. Safety practices, e.g. use of goggles, removal of mushroom heads.	
	b. Types, features and applications of chisels, e.g. cold, cape, round nose, diamond.	
	c. Correct procedures.	
4. Punching	a. Features and uses of various punches, e.g. solid, centre, prick, drift, aligning.	
5. Hand Sawing	a. Types, features and application of hand saw blades.	
	b. Correct selection of the hack saw blades for various thicknesses and kinds of metal.	
6. Filing, draw filing, filing to compound curves, polishing.	a. Nomeclature and selection of files.	
	b. Care and use of files	
	c. Techniques of filing	
	d. File cards	
	e. Emery cloth and grades, stones and powders	
7. Drilling	a. Care, use, features and functions of hand drill, electric drill, drill press	
	b. Methods of holding stock while drilling	
	c. Drill speeds	
	d. Sizes and specifications of drills	
	e. Cutting oils	
	f. Sharpening of drills	
	g. Countersinking methods	

Operations	Basic Information	References
8. Reaming	a. Reamers	
	b. Purpose for reaming	
9. Hand Tapping and External Threads	a. Hand tools, wrenches, screwdrivers	
	b. Types, features and applications of standard screw threads	
	c. Types of taps and dies	
	d. Methods of holding and driving hand taps	
	e. Precautions concerning tap breakage	
	f. Methods of holding and driving dies	
	g. Cutting oils	
	h. Tap drill sizes	
	i. Taper taps, plug taps, bottom taps	
10. Countersinking, riveting, other fasteners	a. Rivets, kinds, uses	
	b. Use of countersink	
	c. Countersinking with drills	
	d. Rivet sets	
	e. Bolts, kinds, uses	
	f. Keys, taper pins, etc.	

Operations	Basic Information	References
1. Lathe Work		
a. Truing up work facing or squaring, parallel turning, parting, chuck turning, turning between centres, drilling, tapping, using the micrometer caliper.	a. Parts of the machine, their features and functions.	
	b. Methods of mounting work	
	c. Types, features, functions and limitations of chucks	
	d. Features and functions of measuring and testing tools, e.g. calipers, micrometers, gauges, indicators.	
	e. Selection and control of speeds and feeds	
	f. Types of lathe tools, their design and function.	
	g. Methods of mounting cutting tools	
	h. Safety principles and practices	
2. Centre Drilling	a. Types, features and functions of drills	
3. Filing	a. Types of files and their uses	
	b. Safety factors	
4. Polishing	a. Kinds of abrasive material and their uses	
	b. Types of lathe tools, their design and function	
5. Taper Turning	a. Types, features and functions of tapers	
6. Cutting V Threads	a. Taper setting in degrees	
	b. Cleaning of threads	

Operations	Basic Information	Reference
7. Power Sawing	a. Holding of materials	
	b. Safety principles and practices	
	c. Coolants	
8. Grinding	a. Types, features and functions of abrasives and grinding wheels	
	b. Care of grinding wheel surface	
	c. Types of wheel dressers and how to use them	
	d. Safety principles	

HOT METAL WORK

Operations	Basic Information	References
Heat Treating Metal		
1. Drawing to a point	a. Proper heat	
	b. Tools	
2. Drawing to a flat	a. Tool Steels	
	b. Carbon content	
3. Bending and Shaping	a. Carbon content	
4. Hardening and Tempering	b. Spark test	
	c. Heat treatment	
	d. Jigs and vices	
	e. Forming	
	f. Finishing	
	g. Bluing	

Operations	Basic Information	References
1. Layout Work		
2. Cutting	a. Kinds of sheet metal and uses	
3. Forming	a. Gauge of sheet metals	
4. Fastening	a. Fastening with rivets	
5. Soldering	a. Soldering - kinds fluxes soldering irons tinning of coppers preparation of surface	
	b. Methods of reinforcing	
	c. Seams and joints	
	d. Sweat soldering	
	e. Soldering of pipes and tubes	
	f. Blow torch	
	g. Propane torch	
	h. Short-cuts for layout - square to square round to round square to round	

REFERENCES

1. Machine Shop Theory and Practice - Halletts - MacMillan Company

2. Machine Tool Metalwork - Fierer & Tatro - McGraw-Hill

3. General Metal - Fraser & Bidell - Prentice-Hall

4. Sheet Metal Principles & Procedure - Stieri - Prentice Hall

5. Fundamentals of Machine Shop - Stieri - Prentice-Hall

6. General Industrial Shop - Johnson - McGraw-Hill

7. Metal Work - Technology & Practice - Ludwig - McKnight & McKnight

8. Machine Tool Operation, Part 1 - Axelrod & Anderson - McGraw-Hill

9. Machine Shop Math - Exelrod - McGraw-Hill

10. General Metals - Feirer - McGraw-Hill

11. How to Run A Lathe - South Bend

12. Modern Metalworking - Walker - General Publishing

MATERIAL AND DATA

Precision Tools - Moore & Wright (Sheffield) Ltd., Sheffield, England
- Data Sheets for engineering student and engineering apprentices

Fraction and Decimal Charts

Micrometer Chart

Tempering Color Charts

Colored Spark Test Charts

Carbon Graph

No doubt many good wall charts of various machines are available from the companies from whom the machines are purchased.

Films - Shop Safety and Machine Operations

Slides

Work Activities	Basic Information	References
The Internal Combustion Engine		
1. Elementary work on small gas engine practice units. To include two stroke cycle and four stroke cycle single cylinder units.	Design and operating principles of the two stroke cycle and the four stroke cycle engine.	Purvis
	Cylinder arrangements, types of cylinder heads, cylinder ports and transfer ports.	
2. Complete disassembly, inspection, construction, names and operation of parts. Use of special tools, gauges and measuring instruments for determining clearances and wear.	Valve design, valvesprings, retainers, locks, valve guides lifters, pushrods and rocker arms.	
	Camshaft and timing gears, timing chains, timing marks, valve timing.	
	Piston design and assemblies. Identification of parts and marking.	
3. Examine bearings and measure clearances.	Crankcase, crankshaft, types and construction of bearings, connecting rods. Flywheels: design and purpose.	McGuffin
	Manifolds, ports, mufflers: purpose and construction.	
4. Trace lubricating and cooling systems.	Purpose and methods of lubrication. Properties of oil, contamination, consumption, oil changes.	
5. Study various types of lubrication systems: oil pumps, filters and pressure indicators. Purpose of dippers, trays and baffles.	Types of lubrication systems: splash, pressure feed and combination.	Crouse

Work Activities	Basic Information	References
6. Remove and install oil seals	Oil seals: purpose and construction	
7. Study air and liquid cooling systems	Heat transfer, operating temperatures. Types of air and liquid cooling systems.	
Fuel System		
1. Study fuel tanks and fittings.	Construction of fuel tanks, fuel lines, fuel filters and types of fittings.	Nash
2. Cut and flare tubing.		
3. Examine simple carburetors. Sketch circuits for simple carburetor.	Fundamental principles of carburation, basic circuits, principles of operation, air-fuel ratios, volumetric efficiency.	
4. Service Air Cleaners	Air cleaners, types, servicing.	
Ignition System		
1. Assembly and disassembly of magneto ignition systems.	Electricity and Magnetism: Electrical units, Ohms' Law.	Purvis
2. Trace primary and secondary circuits.	Circuits: simple, open, closed. Shorted, grounds, series, parallel, series-parallel.	
3. Install and adjust contact breakers.		
4. Ignition timing.	Magnetism, electromagnetism, induction.	
5. Clean and gap spark plugs.		Crouse

Work Activities	Basic Information	References
6. Splice wire and solder terminals to wire.	Types of wire used in automotive work.	
7. Installing solderless terminals.	Soldered and solderless terminals.	
Engine Operation		
1. Assemble engine and make running adjustments.	Carburetor adjustments.	Purvis
2. Set valve tappet clearances. Ignition timing.	Tappet clearances: purposes and methods of adjustment. Ignition timing and advance. Principles and operation of engine speed governors.	
3. Adjust engine speed governors.		

REFERENCES

1. Purvis: ALL ABOUT SMALL GAS ENGINES. General Publishing Co.
2. Nash: AUTOMOTIVE FUNDAMENTALS. McGraw-Hill
3. McGuffin: AUTOMOTIVE MECHANICS * PRINCIPLES AND OPERATION
4. Crouse: AUTOMOTIVE MECHANICS - McGraw-Hill
5. Crouse: AUTOMOTIVE ENGINES - McGraw-Hill
6. Kates: DIESEL AND HIGH COMPRESSION GAS ENGINES. FUNDAMENTALS 2nd ed. General Publishing Co.
7. Crouse: AUTOMOTIVE ELECTRICITY. McGraw-Hill
8. Duff: ALTERNATING CURRENT FUNDAMENTALS, Delmar.
9. Canadian Electrical Code, Part 1, 8th ed.
10. Jones: FARM GAS ENGINES AND TRACTORS, 4th ed. McGraw-Hill

POWER TRANSMISSION

This section of Agricultural Mechanics should deal with all aspects of power transmission used in the farming industry. The student should be made aware of the simplest application of power transmission to the more complex. Repair and design of the units discussed should be brought to the student's attention. Repair should be done to those parts that can be repaired, keeping in mind that machining has previously been taught.

Constant consideration should be given to design for the purpose of proper repairing methods, for consideration in buying new equipment, and for the implementation of new ideas to new machines.

Operations	Basic Information	References
1. Levers Lab. illustrations performed for students.	a. Classes of levers defined b. Purpose of levers c. Application to everyday farm life d. Application to Machines e. Theory and calculations of each class	
2. Pulleys and Belts Math calculations involving flat and "V" belt pulleys	a. Design b. Materials c. Applications d. Theory	
3. Friction Wheels	a. Applications e.g. Rubber tire drive to flat pulley	
4. Gears Problems in simple and compound gearing	a. Types of gears b. Design c. Material d. Applications	
5. Worm and Gear	a. applications	
6. Bearings	a. applications	

Operations	Basic Information	References
7. Transmissions		
Student should have a chance to observe actual units and know how they work. Actual repair if time permits	a. Purpose b. Arrangement of gearing c. Planetary gearing	
8. Differentials Observation of as many units as possible. Repair if time permits.	a. Purpose b. Design c. Adjustments	
9. Clutches Minor repairs should be made to a simple friction clutch.	a. Friction b. Cone c. Positive Sq. Jaw Spiral Jaw	
10. Chains and Sprockets Chains should be dismantled and assembled,	a. Design and purpose b. Materials of which they are made c. Applications on farm machinery d. When to repair e. How to repair	
11. Cams and Cranks	a. Methods of changing circular motion to reciprocating motion b. Application to Machinery	
12. Power Take-offs General repair to a twisted, bent or worn power take off shaft Repair of universal joints.	a. Safety b. Tractors - connections to implements c. Transmission connections to hydraulics, etc. d. Speeds e. Direction f. Splines, key-ways, set screws g. Universal joints h. Flex shafts	

Operations	Basic Information	References

13. Hydraulics

Problems involving square inches, cubic inches, gallons, pressures per sq. in. ratio and proportion, etc. should be given to the students.

Students should actually overhaul a gear or vane pump in the shop. Machining is usually necessary.

a. Basic theory of fluids
   - Pascal's Law -
b. Advantages and disadvantages of high and low pressure systems
c. Basic hydraulic circuits
   - components

d. Pumps - advantages of each
   - Gear
   - Vane
   - Piston

e. Methods of driving pumps
   - P. T.O.
   - Crankshaft
   - Electric
   - Fan belt and magnetos
   - Hand
   Power required for each type of pump according to the G. P. M. output.

Repair can be made to a worn or damaged cylinder.

f. Hydraulic cylinders
   Selection as to distance force, speed and mounting.

g. Conrol Valves
   - Open centre
   - Closed centre
   - Single, etc.
   - Service
   - Parallel

h. Relief valve
   - Purpose
   - Position
   - Types

i. Oil Lines
   - Pressure and capacity
   - Size
   - Types

Operations	Basic Information	References
	j. Filters - Purpose - Types	
	k. Hydraulic Oils - Care - Temperature	
	l. Pressure Gauges	
	m. Fittings	
	n. Couplings	
	Couplers	
	p. Motors - Types - Advantages - Horse Power - Torque - Large field of application	

TRANSMISSION OF POWER

Reference Books

1. Elements of Machine Design

   - Emanuel Rosenthal and
     George P. Pischaf
     McGraw-Hill Book Co.

2. Machine Tool Operation (Part 2)

   - Burqhardt, Axelrod and Anderson
     McCraw-Hill Book Co.

3. Power Mechanics

   - Pat H. Atteberry
     The Goodheart-Willcox Co.

4. Farm Power - Moses and Frost

5. Farm Machinery and Equipment "Smith"

FARM MACHINERY

The section on Farm Machinery in a sense, forms a portion of the central core for the other sections. The other sections provide the knowledge and skills in the use of tools in order to service and maintain farm machinery. This knowledge and skill can only be applied in terms of an understanding of the various units of farm equipment and machinery. The students must have an understanding of the purpose for which each of the following pieces of equipment was designed, how it is designed, the working conditions to which it is subjected, in order that they may service and maintain the equipment in an intelligent and understanding manner.

In order to make this section meaningful to students, the instructor will have to secure the cooperation of farm implement dealers and farmers in order to obtain equipment for students to examine, set up and service. Frequent field trips to farms and equipment demonstrations will be an essential part of the program. The District Agriculturalist can also be of assistance if asked, in keeping you informed of significant developments and activities that would be of value and interest to your classes. He may also speak to your class on topics that you feel inadequately equipped to cover. Information with regard to the opportunities in the field of agriculture can be provided by the District Agriculturalist.

It is expected that all of the equipment listed below will be studied. However, the depth of study and experience with a particular piece of equipment will be dependent upon whether or not the equipment is one which is suited to the farming methods and crops that are typical of the area in which the school is located. For example, it is doubtful if a sugar-beet harvester could be located anywhere other than the southern part of the province of Alberta.

INTRODUCTION

Operations	Basic Information	References
	A. The relationship of farm machinery to the development of agriculture. 1. The development of farm mechanization. 2. Power versus manual labor.	

perations	Basic Information	References
	A. Moldboard Plows.	
	1. Terminology a. bottom or base - share, landside, moldboard b. frog c. beam d. furrow - furrow slice, back furrow, dead furrow, furrow wall	H. P. Smith Manufacturers' charts and specifications
Examine various types of moldboards and shares.	2. The Moldboard - a. types of moldboards b. types of moldboard materials	
Check the adjustments for suction on a trailing plow.	3. Plow Shares - a. Parts of the share b. Suction - vertical or down suction; horizontal or land suction	
	4. Size of the plow	
	5. Regular trailing plows a. sizes b. parts and their function c. two-way trailing plows	
	6. Semi-mounted plows	
	7. Mounted plows a. controls-lever and hydraulic	
	8. Integral-mounted middle-breakers	
	9. Design of moldboard plows a. main points to consider b. forces that act on the plow c. center of load of a plow bottom	H.P. Smith p.p. 106

Operations	Basic Information	References
	d. influence of friction on design e. effect of speed on design f. types of soil and methods to aid scouring g. frame design h. accessories - rolling colter, jointer, combination rolling colter and jointer, concave rolling disk colters.	
	B. Disk Plows	
	1. Advantages of disk plows 2. Tractor disk plows a. Regular trailing disk plow b. tiller or one-way trailing disk plow	H. P. Smith p.p. 116
Examine tiller for construction, design and adjustments. Demonstration of hitching and adjusting.	i. design characteristics ii. reasons for its popularity iii. speed of operation iv. size of disks v. one-way disk adjustment vi. principle of hitching vii. points of wear viii. servicing procedure	
	C. Rotary Plows	
Examine rotary plows for design and points of wear. Service self-propelled rotary plow.	1. Auxiliary - engine rotary plow 2. Tractor-mounted power-take-off rotary plow 3. Self-propelled garden-type rotary plow	See manufacturers' specifications and service instructions
	D. Chisel and Subsurface Plows	
	1. Chisel plows a. design b. function c. operation d. types of points	
	2. Subsoilers a. purpose b. design	

Operations	Basic Information	References
	E. Hitches for Plows	
	1. Moldboard trailing plow hitches a. vertical principles b. horizontal principles i. horizontal line of draft ii. center of power iii. center of load iv. side draft or pull	H. P. Smith p.p. 131
Locate vertical line of draft on a plow and tractor and adjust hitch.		
Locate horizontal line of draft for the above combination and make the necessary adjustments. Examine and adjust plow for depth and level according to manual.	2. Semimounted plows	
	3. Integral-mounted plows a. threepoint hitch - leveling, depth and suction adjustments	ASAE Standards
	4. Disc-plow hitching a. vertical and horizontal adjustments b. adjusting for width of cut.	
Make the necessary adjustments on a one-way and tractor and test in the field. Assemble a new one-way disc plow. Replace bearings and seals on one-way disc plow.	5. One-way disc plow hitch a. horizontal adjustment b. vertical adjustment c. multiple unit and tandem hitches.	Martin and Stephanson

SECONDARY TILLAGE EQUIPMENT

Operations	Basic Information	References
	A. Harrows	
	1. Disk harrows	
	a. uses of disc harrows	H.P. Smith
	b. types of disk harrows	p.p. 145
	i. trailing -single action, double action, off-set, heavy duty	
	ii. mounted disk harrows - direct-connected, pick-up and lift-type	
	c. Component parts of the disk harrow	
Study various types of disk harrows. Examine various types of bearings.	i. disks-round and notched	
	ii. disk sizes	
	iii. disk gangs	
	iv. harrow frames	
	v. bearings	
	vi. bumpers	
	vii. scrapers	
	viii. weight boxes	
	d. leveling for even penetration	
	e. factors determining soil penetration	
	f. power angling of gangs	
	2. Spike-tooth harrows	
	a. description	
	b. uses	
	3. Spring-tooth harrows	
	a. description	
	b. uses	
	4. Special harrows	
	B. Land Rollers and Pulverizers	
	1. Surface packers	H. P. Smith
	a. kinds or shapes	p.p. 157-61
	b. uses of surface packers	
	2. Subsurface packers	
	a. description	
	b. uses	

Operations	Basic Information	References
Study the operation of cultivators and service.	C. Subsurface Tillage Tools and Cultivators 1. Definition of subsurface tillage 2. Advantages 3. Field cultivators 4. Rod weeders 5. Cable weeders	H. P. Smith p.p. 162

PLANTING EQUIPMENT

Operations	Basic Information	References
Examine grain drills. Assemble new drills and repair used drills.	A. Classification of Planting Equipment 1. Row-crop planters 2. Broadcast-crop planters 3. Drill planters 1. grain drills - trailing and mounted; size of drill, drill frame, types of feed, calibration; furrow openers, hitches; attachments for grain drills.	H.P. Smith p.p. 196-207

CULTIVATION AND WEED CONTROL EQUIPMENT

Operations	Basic Information	References
Check the setting of cultivator shovels and sweeps.	A. Cultivators and their function B. Types of cultivators 1. Row-crop cultivators 2. trailing-type cultivators 3. cultivator shanks 4. shovels and sweeps	H. P. Smith p.p. 209

Operations	Basic Information	References
	C. Flame Weed Control 1. types of equipment 2. operation	
	D. Chemical Weed Control 1. Pre-emergence application 2. Post-emergence application	
Service spray equipment according to manufacturers' specifications	E. Spraying and Dusting Equipment 1. Kinds of sprays 2. Functions of a sprayer 3. Types of sprayers a. hydraulic sprayers - operation, pumps, tanks, agitators, gauges, regulators, valves, spray heads, spray booms, and nozzles. 4. Airplane sprayers a. droplet size and effect b. spray nozzles for aircraft 5. Dusting equipment - types of dusters	H. P. Smith p.p. 237-55

FERTILIZING EQUIPMENT

Operations	Basic Information	References
	A. Purposes of fertilizing	
	B. Basic types of fertilizers	
Examine drive mechanisms and service	C. Equipment 1. manure spreaders - types, construction, operation 2. fertilizer attachments a. row-crop attachments b. grain drill attachments 3. broadcast fertilizers a. metering devices b. applicator chisel knives	H.P. Smith p.p. 269-86

REFERENCES

Harris Pearson Smith: Farm Machinery and Equipment, McGraw-Hill Book Co., 1964 edition.

Martin, E. B. & Stephanson, B. T.: One-way Disc Maintenance and Operation, University of Alberta, Department of Agriculture, Pub. 6, 1948.

A.S.A.E. Standards: Three-point, Three-link Attachment for Hitching Implements to Agricultural Wheel Tractors, Agr. Engin. Yearbook, 8th edition, 1961.

AGRICULTURAL MECHANICS 32
(15 or 20 credits)

This course consists of four major divisions:

I	- Farm Power Units	- 5 credits
II	- Farm Machinery	- 5 credits
III	- Farm Buildings	- 3 credits
IV	- Welding	- 2 credits

Those schools wishing to offer the course for 20 credits should divide the additional time among the four areas according to their present time allottment.

TEXTS

"Shopwork on the Farm," Mack M. Jones, 2nd edition, Webster-McGraw-Hill Book Co.

"Farm Machinery and Equipment", H. P. Smith, 5th edition, McGraw-Hill Book Co.

Work Activities	Basic Information	References
Service work on a representative selection of automotive and tractor engine units. To include both gasoline and diesel fuel engines.	A detailed comparison of the spark-ignition engine with the compression-ignition engine.	
Study different types of multi-cylinder engines, operating characteristics and starting mechanisms.	Types and characteristics of multi-cylinder gasoline engines. Diesel engine types including modern high speed automotive, truck and tractor engines. L.P.G. systems. Diesel engine starting systems. Operating and maintenance expenditures.	Kates F. R. Jones p.p. 286
Take compression, vacuum and fuel pressure readings on running units.	Indicated and Brake horsepower. Compression ratios, combustion processes and efficiency ratings.	F. R. Jones p.p.452-54
Fuel Systems (Gasoline)		
Disassembling and assembling fuel pumps, single and double.	Types and operation of fuel pumps	F. R. Jones p.p. 169-191
Disassembly and assembly of carburetors:	Carburetor circuits: principles and operation.	
(a) adjust float level, metering rod.	Carburetor troubles and remedies.	Crouse Chapt. 9
(b) Fast idle, anti-percolator, automatic choke, unloader, idle.	Fuels and compression ratios, octane ratings, fuel additives Care and storage of fuel	
(c) Tracing idle, low speed, intermediate speed, power and automatic choke circuits		
Service air cleaner and breather.	Types of air cleaners and breathers.	

Work Activities	Basic Information	References
Fuel Systems (Diesel)		
Disassembly and assembly of fuel systems: fuel lines, filters, transfer pump, injection pumps, injectors.	Types of fuel injection systems: pumps, injectors and fuel metering mechanisms.	Crouse Chapter 9
Injector tests. Priming and bleeding fuel systems. Diesel pump timing.	Possible troubles and their remedies.	
Governor linkage adjustment. Use of pyrometer.	Field testing procedures, importance of cleanliness.	F.R. Jones Chapter 12
	Diesel fuels: flash point, viscosity, cetane ratings, care and storage, filter systems.	
Service air intake systems.	Air intake systems: blowers, air cleaners. Principle and operation of turbo-chargers	F. R. Jones p.p. 193-98
Cooling Systems		
Removing and replacing radiator	Radiator pressure caps, purpose and how to test.	F.R. Jones p.p. 199-211
Removing and replacing water distributing tube.	The effect of improperly installed water distributing tubes: the effect of foreign deposits in the passage ways.	
Removing and replacing expansion plugs.	Expansion plugs: function and precautions in fitting.	Crouse Chapter 12
Removing and replacing fan assemblies. Fan belt adjustment.	Types of fan assemblies.	
Removing, inspecting and replacing water pump.	Servicing water pumps. Reasons for pump failure.	
Winterizing by use of antifreeze.	Specifications, volume of cooling system, amount of antifreeze required, rust inhibitors, use of antifreeze testers.	
Checking cooling system.	Cause of leaks; how to locate internal and external leaks and how to repair them.	

Work Activities	Basic Information	References
Lubricating System		
Trace lubricating system, change filters and check for leaks.	Types of oil pumps; full-flow and by-pass oil filters, oil coolers, pressure regulating valves; properties of lubricating oils.	F.R. Jones
Electrical System		
Battery service: clean and service battery, cables and hold-downs. Check specific and cell voltage.	Types and construction of batteries. Battery servicing: removal, testing and installation.	F.R. Jones Chapter 17
	Battery chargers and connections.	
Circuits: tracing and testing electrical circuits.	Test equipment, use of voltmeter, ammeter, measuring resistance.	Crouse
Servicing and testing of fuses, circuit breakers, switches and relays. Soldering, splicing, removing and replacing terminals.	Types of electrical circuits. Identification and precautions for alternator equipped units. Operation of relays and solenoids.	
Ignition: preliminary tests on distributor, service and replace points. Test coil and condenser.	Purpose and construction of coils, condensers and contact breakers. Tests for coils and condensers.	Crouse Chapter 26
Operating a distributor on a test stand: setting cam dwell, inspection and adjustment of automatic advance mechanisms.	Spark advance, pre-ignition, effects of late timing.	
Installation and ignition timing; using timing light.	Timing procedures.	
Testing and timing a magneto system.	Purpose and construction of impulse couplings.	F.R. Jones Chapter 19

Work Activities	Basic Information	References
Starters: Disassembly and assembly of starter motors, cleaning and testing.	Types and operating principles of D. C. starter motors.	F.R. Jones Chapter 21
Testing of motor for speed and torque,	Armature tests, field coil tests.	Crouse Chapter 24
Test armatures and field coils.		
Turning and undercutting armatures, replacing and seating brushes.	Procedure and necessary precautions.	
Checking starter drive units, starter switches, relays and solenoids.	Operation of various types of bendix and starter drive units.	
Generators: Disassembly and assembly of generators, identification of parts, tracing and testing of circuits. Use of growler.	Correct procedures and use of test equipment.	F.R. Jones Chapter 21
Checking and servicing of bearings, brushes, brush-holders and springs.	Polarizing generator. Regulators: purpose and construction.	Crouse Chapter 25
Check unit on test bench.	Correct testing procedures.	
<u>Service Work</u> (Valve grind)		
Remove units attached to cylinder head, spark plugs, injectors, head bolts.	Precautions necessary in removing head bolts, nuts and head.	F.R. Jones Chapter 10
Clean and check head; use carbon scrapers and brushes.	Effect of carbon deposits.	
Remove engine valves.	Necessary precautions in removing valves. Valve stem seals and their function.	

Work Activities	Basic Information	References
Clean, check and reface valves. Use of valve refacing machine.	Valve face angles, sodium filled valves, width of margin, effect of valve stem wear and how to check	Crouse Chapter 18
Cleaning, checking and replacing valve guides		
(a) use of valve guide cleaners (b) checking valve guide wear (c) how to remove guides (d) use of reamers	Precautions necessary.	
Checking and replacing valve springs. Test spring tension.	Construction of valve springs, purpose of dual springs, closed coils. Correct installation, effect of weak springs.	
Reconditioning valve seats:		
(a) use of valve seat refacing machine (b) check seat and face contact.	Valve seat angles and width. Importance of clean valve guides. Types of cutters and grinding stones. Materials used in valve seats. Use of grinding compound to check face and seat contact.	
Removing, checking, refacing and replacement of valve lifters. (a) reface lifters (b) install lifters	Causes of valve lifter wear Operation of hydraulic valve lifters. Precautions when installing valve lifters.	
Reconditioning rocker arms and shafts: (a) rebushing and fitting (b) clean and check (c) install rocker arms	Necessary precautions. Procedure for rebushing and checking. Differences between intake and exhaust rocker arms.	Crouse Chapter 18
Adjusting tappets, use of feeler gauges.	Tappet locking devices, requirements for setting tappets on a dead engine, necessity for grinding valve stem or face, precautions when adjusting hydraulic tappets.	

Work Activities	Basic Information	References
Installation of head:		
(a) use of gaskets and seals (b) use of torque wrench	Necessary precautions, types of gaskets, sequence of tightening head bolts, torque.	
Removing and replacing intake and exhaust manifolds:		
(a) clearing manifold passages (b) installation of gaskets (c) freeing manifold heat-control valve	Importance of cleaning manifold, how to check manifold, carburetor, heat tubes and valves.	
Examination and study of different types of electric motors. Identification of leads, tracing circuits, terminal marking systems.	Types and operating principles of electric motors: D.C. series and shunt, universal A.C. - D.C.; A.C. motors: split phase, capacitor, shaded pole, repulsion induction.	Duff
Observation and testing of units under load.	Power supplies. Selection of motors, load requirements, starting torque, current draw. Starting and running windings.	
Installation of motors, alignment of couplings. Connect motor to power supply.	Correct procedures. Types of couplings and how to install. Calculation of wire sizes and safety factors; fuses, overload devices, starting switches. Reversing rotation of motor.	
Disassembly of motor, cleaning, checking and lubrication.	Motor care and maintenance.	M.M. Jones p.p. 590-592

For references refer to Page 41 of this guide.

Operations	Basic Information	References
	Hay Harvesting Equipment	
Examine various mowers as to design and mounting. Check operation of safety release clutch. Remove and release clutch. Remove and replace worn or broken knife sections. Sharpen mower knives. Replace worn ledger plates. Check and adjust registration.	1. Tractor mowers a. trail-behind b. rear mounted c. central mounted d. safety release clutches e. knife drives f. cutter bar and its parts g. registration h. cutter bar attachments	H.P. Smith p.p.289-99 Jones p.p. 557-63
	2. Hay Conditioners a. the smooth roll b. the corrugated roll	Smith p.p.300-02
Service hay rakes and replace worn fingers	3. Hay Rakes a. dump rakes b. side delivery rakes i. cylindrical reel ii. parallel bar or side stroke iii. finger wheel c. sweep rakes	
	4. Hay loaders	
	5. Hay stackers	
	6. Hay balers a. pick-up automatic self-typing i. tying mechanisms ii. trouble shooting b. bale throwers c. bale loaders	
Check operation service and repair equipment	7. Forage Harvesting equipment a. row-crop forage harvesters b. field chopper harvesters c. self-propelled forage harvesters d. silo forage blowers	

Operations	Basic Information	References
	8. Grain Harvesting Equipment a. development of the binder and thresher b. grain combines i. advantages and disadvantages ii. types of combines c. functions performed	
Examine combines as to operating mechanisms, adjustments, points of wear.	i. the cutting mechanism ii. threshing mechanism iii. separating mechanism iv. cleaning mechanism	H.P.Smith p.p.329-340
Service and repair combines.	v. attachments - pick-up, straw spreader, windrower, straw loader, straw chopper, bagger, grain bin, weed cleaner.	
	d. windrawing machines (swathers) i. advantages of swathing ii. disadvantages of swathing.	
Repair cutter bars and canvasses. Service swathers.	9. Root Harvesting Equipment a. potato harvesters i. types of diggers ii. construction and operation iii. potato combine	H.P.Smith p.p.383-6
Examine operating mechanism, service and repair.	b. sugar beet harvesters i. tractor drawn ii. tractor mounted iii. design and operation - tapping, lifting, cleaning iv. beet combines	
	10. Crop Processing Equipment a. feed grinders and mills i. burr grinders ii. hammer mills iii. feed mixers iv. crop driers	H.P.Smith p.p.420-39
Study operation and service	11. Laborsaving Equipment a. elevators i. chain drag-flight elevator ii. auger type iii. blower type	
Service and repair as available and required	b. truck and wagon hoists c. tractor-hitch utility carrier d. power loaders e. power post-hole diggers f. brush cutting equipment	

Operations	Basic Information	References
	12. Farm Tractors	
	a. history and development of tractors	F.R.Jones
	b. types of farm tractors	Chapter 3
	i. according to methods of traction	
	ii. according to utility	
	c. all purpose tractors	
	i. design	
	ii. power	
	iii. speed	
	iv. capacity	
	d. Power and engine efficiency	
	i. horsepower of engines	
	ii. drawbar horsepower	
	iii. belt horsepower	F.R.Jones p.p.48-60
	e. tractor engine types and construction	
	f. governors and governing systems	
	g. magneto ignition	F.R. Jones p.p.212-17
	i. types and construction	
	ii. high-tension magneto	
	iii. impulse starter couplings	F.R.Jones Chapter 1[illegible]
	h. Diesel engine construction and operation	
	i. two and four stroke cycle diesels	F.R.Jones Chapter 2[illegible]
	ii. fuel injection	
	iii. diesel starting methods	
	i. Tractor clutches and transmissions	
	i. multiple disc clutch	
Dismantle and assemble clutches.	ii. single plate clutch	F.R. Jones
	iii. dual plate clutch	p.p.349-355
Adjust clutch tension.	iv. clutch troubles and adjustments	
Dissassemble and assemble tractor transmissions	j. Tractor transmissions	
	i. gear ratios and travel rates	
	ii. transmission types	F.R. Jones
	iii. differential construction	Chapter 2[illegible]
	iv. differential operation	
	v. differential location	
	vi. differential locks	
	vii. final drives	
	viii. tractor brakes	
	ix. track type tractor transmissions	
	x. special transmission types-hydraulic, dual range, automatic, tractor torque converters	

Operations	Basic Information	References
	k. Traction and steering mechanisms	
	i. steel wheels	
	ii. rubber tires	
	iii. track mechanisms	
Check tire pressures	iv. front axles	
Fill tires with anti-freeze	v. steering mechanisms	
	vi. power steering	F.R.Jones
	vii. pulley and belt speeds	Chapter 24
Service steering mechanism.	l. Tractor hitches and hydraulic controls	
	i. trailing and mounted machines	F. R. Jones
	ii. drawbar pull and weight transfer	Chapter 25
	iii. drawbars, offset hitches and side draft	
	iv. general rules for hitches and stability	
	v. hydraulic control principles	
	vi. three point hitches	
	vii. side and front mounted tool controls	
	viii. trailing implement control	
	ix. special hydraulic systems	
Service hydraulic units and controls	x. care, lubrication and servicing of hydraulic transmissions and implement controls.	
	m. Engine and tractor servicing	
	i. causes of poor compression	F.R.Jones
	ii. fuel and carburetor problems	Chapter 27
	iii. ignition troubles	
	iv. timing troubles	
	v. overheating	
Time a magneto to an engine	vi. lack of power	
	vii. knocking and pounding	
	viii. engine fails to start	
Trace causes of poor engine operation and correct.	ix. engine hard to start	
	x. engine starts but stops immediately	

FARM BUILDINGS

The successful farmer today must be proficient in the use, repair and maintenance of many kinds of mechanical equipment. Buildings and smaller frame structures are an essential part of any farm operation. It is also essential, therefore, that the farmer possess some basic knowledge and skill of the carpenter in order that he can maintain his farm buildings and if necessary construct small buildings and equipment.

Note: Strong emphasis should be placed on hand tools and frame construction.

Operations	Basic Information	References
	A. Safe practices in the carpentry shop	
	B. Hand tools and instruments.	
	1. Measuring and marking tools	M.M. Jones
	2. Edge tools	Chapter 3
	3. Boring tools	
	4. Fastening and holding tools	
Cut stock for a project.square Square up stock	C. Materials	
	1. Wood - kinds, properties, defects and blemishes, grades, measurement, cost. Plywood	Stanley Tool Guide
	2. Fastening materials - nails, screws, glues	
	D. Common wood joints	
	E. Working drawings	
	F. Power tools	
	1. drill press	M.M. Jones
Assemble project	2. electric drill	Chapter 4
	3. power saws - table, radial, hand electric	
	4. power, grinder	M.M. Jones
Condition common hand tools		Chapter 7
	G. Concrete Work	
	1. Selection of materials	M.M. Jones
	2. determining proportions	Chapter 10
	3. estimating quantities	
	4. form construction	
	5. concrete reinforcing	
	6. measuring and mixing	R.C. Smith
Construct simple concrete projects.	7. placing concrete	Chapter 3
	8. finishing concrete	
	9. curing of concrete	
	10. removing forms	

Operations	Basic Information	References
Frame a small garage, granary or other farm building	H. Frame construction 1. floor framing - joists, headers, trimmers, bridging, sizes of material, spacing, spans, subflooring	R.C.Smith Chapter 4
Layout plates	2. wall framing - plates, studs, cripples, headers, sills, bracing, sheathing	Canadian Farm Building Plans
	3. ceiling joists - size, spacing, spans	R.C.Smith Chapter 5
	4. Roof framing - roofing terms, joist size, span, spacing, common rafter calculations.	R.C.Smith Chapter 7
Field trips to examine typical buildings	I. Post and Beam construction J. Pole Frame buildings K. Rigid Frame structures L. Laminated Arch construction M. Metal buildings	Wood Data Manuals No. 2 and 3 Plywood Man. Assoc. of B.C. publications and plans
	N. Exterior finishing 1. open cornice construction 2. roof sheathing 3. roofing materials- building paper, wood shingles, asphalt shingles, cement asbestos shingles, roll roofing, metal roofing 4. window and door frames 5. experior wall finish	R.C.Smith Chapter 11

REFERENCES

M.M. Jones, "Shopwork on the Farm", 2nd edition, McGraw-Hill Co. Inc., Toronto

Walter E. Durbahn and Elmer W. Sundberg, "Fundamentals of Carpentry, 3rd ed., General Publishing Co. Ltd., Toronto

"Stanley Tool Guide", Stanley Tool Co. Ltd., New Britain, Connecticut

Ronald C. Smith "Principles and Practices of Light Construction", 1963, Prentice-Hall Inc., Englewood Cliffs, N.J.

Canadian Farm Building Plan Service Catalogues, Extension Service, Department of Agriculture, Edmonton, Alberta

Wood Data Manuals No. 1, 2 and 3, Canadian Wood Development Council, Prairie Regional Office, Room 201-84, Isabel Street, Winnipeg 2, Manitoba.

Rigid Frames and Glulam Arches for Douglas Fir Plywood Structures; Plywood Manufacturers' Association of B. C., 550 Burrard Street, Vancouver 1, B.C.

Also - - Douglas Fir Plywood Manual, (Same address as above)

WELDING

OXY-ACETYLENE WELDING

Review Theory and Practice of first year welding

METALLURGY

Operations	Basic Information	References
	1. Identification of Metals Carbon steels - low, medium, high cast iron - gray, white, malleable, aluminum, zinc, base die cast, copper, brass 2. Alloy steels - classifcation according to content and uses 3. Melting points and their application 4. Properties of metals - brittleness, malleability, hardness, ductility, elasticity, plasticity, toughness. 5. Cast iron - production of gray, white, malleable properties, effect of heat on structure; difficulties encountered when welding 6. Processes of heat treatment a. Critical temperature point b. Formation of ferrite, martensite, troosite c. Stresses set up during welding d. Elastic and plastic deformation e. Residual stresses and stress relieving f. Arc and acetylene methods compared 7. Heat Treatment a. Annealing b. Normalizing c. Hardening d. Tempering e. Casehardening	

WELDING CAST IRON

Operations	Basic Information	References
1. Welding cast iron up to 3/8" flat and vertical	a. Characteristics and properties of cast iron	
a. Preparing	b. Identification of cast iron	
b. Preheating	c. Importance of joint preparation	
c. Selecting filler rod	d. Necessity of cleaning metal	
d. Adjusting flame	e. Necessity of pre-heating	
e. Cooling	f. Importance of distortion control	
	g. Purpose of flux	
	h. Correct filler rod	
	i. Correct flame	
	j. Supporting work	
	k. Post-heating	
	l. Cooling slowly	
2. Welding cast steel	a. Identification of cast steel	
a. Building up edges	b. Characteristics and properties of cast steel	
b. Filling holes	c. Importance of clean puddle	
	d. Method of building up edges	
	e. Correct filler rod	
	f. Filling holes	
	g. Cooling slowly	
	h. Pre-heating and post-heating	

Operations	Basic Information	References
3. Brazewelding mild steel, cast iron, malleable castings a. Up to $\frac{1}{4}$" butt, lap, fillet in all positions.		

SURFACING

Operations	Basic Information	References
1. Building up surfaces a. Surfacing with bronze b. Hard facing c. Hard setting	a. Preparation of work piece b. Necessity of build-up prior to hard facing c. Classification of hard-facing materials d. Distortion control e. Cause of deterioration f. "Sweating or tinning" process g. Reason for hard-facing h. Materials normally surfaced i. Purpose of flux j. Factors affecting weld quality k. Annealing hardened steel before hardfacing l. Flame setting m. Metals not possible to hard-face n. Standard sizes and shapes of inserts o. Binding inserts to base metal p. Cooling	

WELDING NON-FERROUS METALS (OPTIONAL)

Operations	Basic Information	References
1. Welding aluminum and aluminum alloys - up to ¼"	a. Identification of aluminum and its alloys b. Characteristics and properties c. Metallurgical effects of welding d. Necessity of using flux and post cleaning e. Joint design f. Selection of filler rod g. Necessity of cleaning metal h. Weldability of different alloys i. Reducing flame j. Torch angle k. Temperature identification	
2. Welding copper and copper alloys such as brass and bronze (flat) 12 gauge	a. Identification b. characteristics and properties c. Weldability of copper and various alloys d. Joint design e. Selection of filler rod f. Purpose of flux g. Post welding treatment h. The zinc problem in welding brass	
3. Brazing with silver solder	a. Definition of brazing b. Characteristics and properties of silver brazing alloys c. Importance of cleaning metal d. Importance of joint design e. Flux as heat indicator f. Flame setting g. Strength of brazed joints h. Flux for different types of silver brazing alloys i. Conductivity of brazed joints for elect conductors j. Selection of silver brazing alloy k. Science: Capillary action	

ARC WELDING

Review Theory and Practice of First Year Welding

WELDING CAST IRON

Operations	Basic Information	References
1. Welding Cast Iron	a. Identify different cast irons	
	b. Characteristics of grey, white and malleable C.I.	
	c. Classification and sizes of electrode	
	d. Preparation of weld	
	e. Arc length	
	f. Machinable cast irons and non-machinable	
	g. Buring C. I. before welding	
	h. When to use cold welding on C.I.	
	i. Preheating and stress relieving-cheap methods	
	j. Sequence of spot heating	
	k. Expansion	
	l. Limitations	

Operations	Basic Information	References
I. Building up surfaces	a. Importance of identifying metal	
	b. Necessity of knowing purpose of weld	
	c. Preparation of weld area	
	d. Methods of welding with ferritic electrodes	
	e. Using austenitic, martensitic and carbide electrodes	
	f. Proper heat and build-up	
	g. Properties of core wire	
	h. Coated and uncoated electrodes	
	i. Properties of deposit and fluxes	
	j. Pre-build-up mild steel rods	
	k. Finishing weld	

WELDING REFERENCE BOOKS

1. Welding Skills and Practices
   - Giachino, Weeks and Brune
   - General Publication

2. Welding Engineering
   - Rossi
   - McGraw-Hill

3. Manual of Instructions in Welding and Cutting
   - Rossi
   - McGraw-Hill

4. Metals and How to Weld Them
   - Lincoln C.

5. New Lessons in Arc Welding
   - Lincoln C.

6. Farm Welding (Arc and Acetylene)
   - Parker
   - McGraw-Hill

7. Arc Welding Lessons for School and Farm Shop
   - Lincoln C.

8. Welding Fundamental Principles and Practices (Arc)
   - Canadian Welding Bureau

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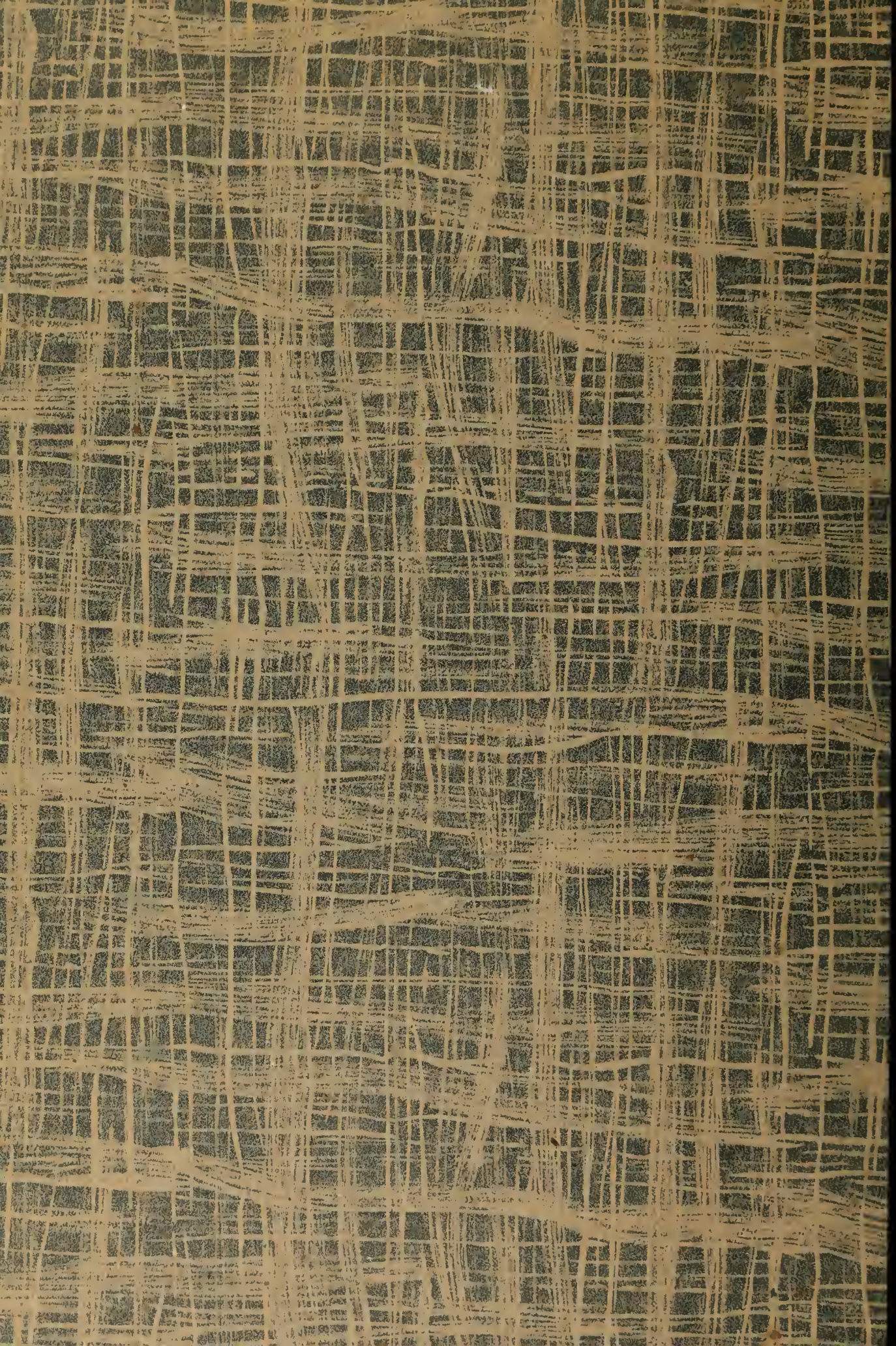
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